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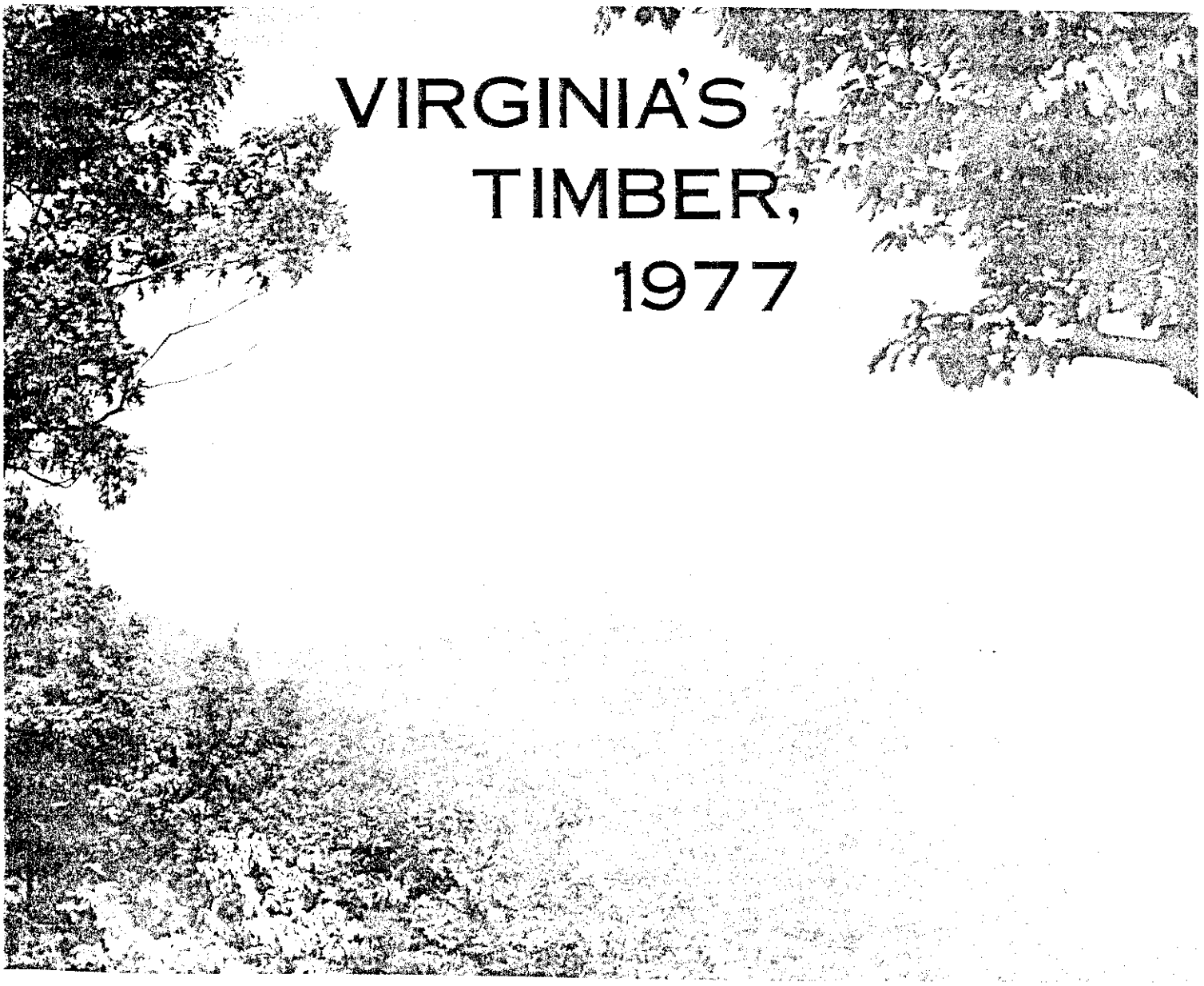

VIRGINIA'S TIMBER, 1977

Southeastern Forest Experiment Station
Asheville, North Carolina

May 1978

CONTENTS

FOREWORD

This report presents the principal findings of the fourth evaluation of Virginia's forest resources. The field inventory was started in February 1975 and completed in March 1977. Three previous Statewide inventories, completed in 1940, 1957, and 1966, provide reference points for measuring changes and trends over the past 37 years. This analysis focuses mainly on changes and trends since 1966.

Five Survey Unit reports issued as the inventory progressed through the State provide additional breakdowns of the data and contain some county tables. Copies of these reports can be obtained from the Southeastern Forest Experiment Station. A Forest Information Retrieval service is also available at the Southeastern Station; forest statistics are compiled at cost for any geographic area within the Station territory.

Section 9 of the McSweeney-McNary Forest Research Act of 1928, as amended, and the Forest and Rangeland Renewable Resources Planning Act of 1974 authorize these forest resource evaluations. The Southeastern Forest Experiment Station, headquartered at Asheville, North Carolina, administers these forest evaluations in Florida, Georgia, North Carolina, South Carolina, and Virginia. The primary objective of these periodic evaluations is to develop and maintain the resource information needed for formulating sound forest policies and programs.

The combined efforts of many people have gone into this inventory and evaluation of Virginia's forest resources. Appreciation is expressed to all Work Unit and Station personnel who participated in the field and office work. The Southeastern Station gratefully acknowledges the cooperation and assistance provided by the Virginia Division of Forestry, The Chesapeake Corporation of Virginia, Continental Forest Industries, Weyerhaeuser Company, and Virginia Polytechnic Institute & State University. Special appreciation is also expressed for the excellent cooperation of other forest industries, private landowners, and public agencies in providing information and allowing access to the sample locations.

Finally, the evaluation of many benefits derived from Virginia's forest resources is beyond the scope of this report. The purpose of this report is to evaluate the timber situation.

DAVID B. THORUD, Assistant Station Director for Continuing Research, Carolinas-Virginia

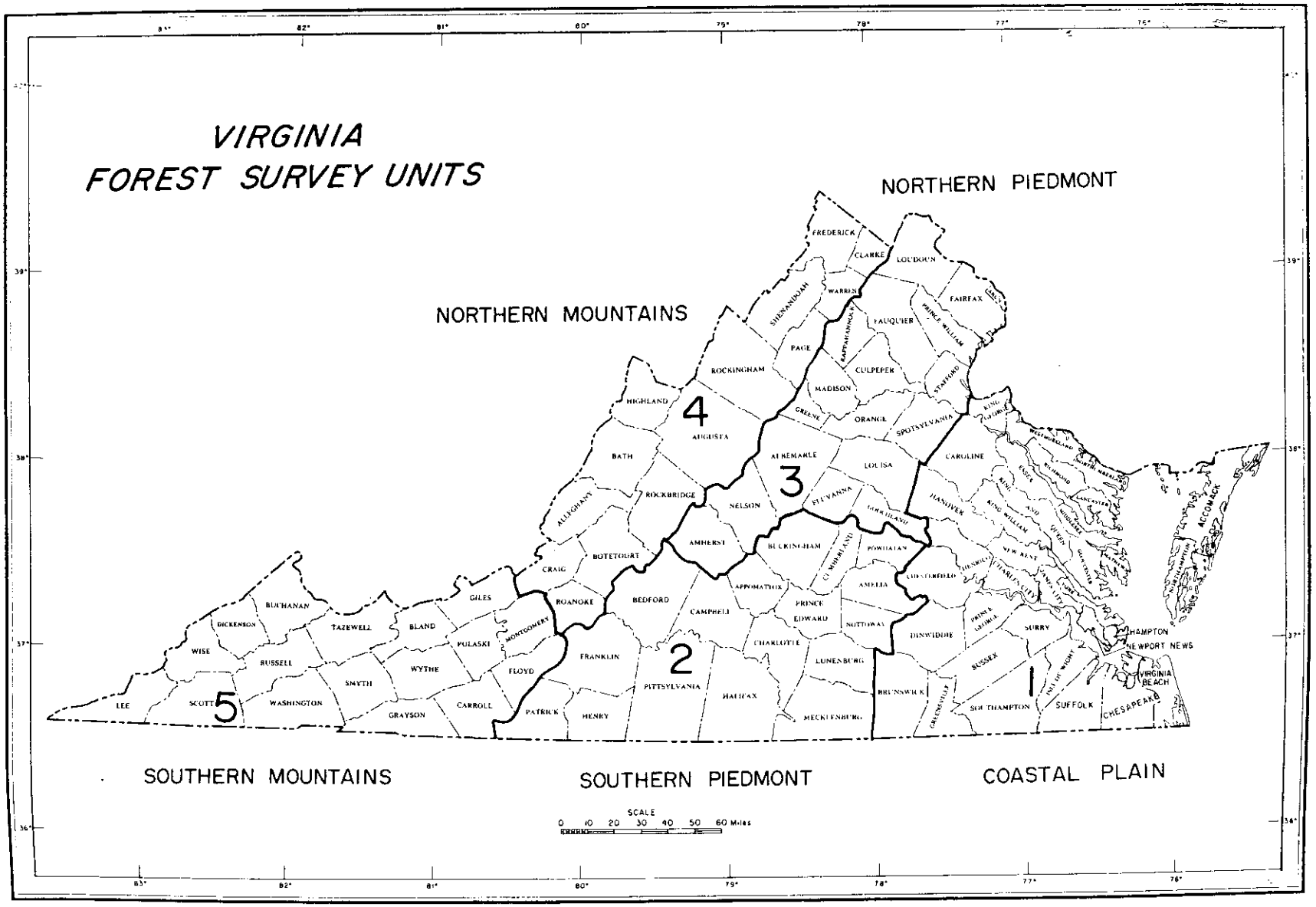

Figure 1. — Forest Survey Units in Virginia.

VIRGINIA'S TIMBER, 1977

by

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and

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HIGHLIGHTS

Since the third inventory of Virginia's forest resources was completed in 1966–

–area classified as commercial timberland increased from 15.8 to almost 16.0 million acres, or less than 1 percent. Reversion of former agricultural lands to forest, mostly in the Northern Piedmont, and reclassification of some marginal sites on the National Forests in the Mountain Region accounted for most of this small net increase. Acreage of commercial timberland declined slightly in both the Coastal Plain and Southern Piedmont. Prospects for any further increase in acreage available for timber production are dim. Acreage of idle cropland, the primary source of new forest land, is shrinking.

–the downward trend in forest ownership by farmers continued but at a slower rate. Between 1957 and 1966, acreage of farm woodland declined from 10.1 to less than 7.0 million acres. The 1977 inventory classified 6.2 million acres as farmer owned. Collectively, farmers and other private, nonindustrial landowners still control 12.3 million acres, or 77 percent of the commercial timberland. Forest industries increased their timberland base to almost 1.7 million acres, or by 7 percent. These statistics indicate, however, that forest industries have slowed their rate of land acquisition. Publicly owned timberland has increased gradually to almost 2.0 million acres.

–rate of successful pine regeneration averaged almost 71,000 acres annually compared to only 56,000 acres during the preceding decade. Still, a strong successional trend from pine to hardwood continued. Between 1957 and 1977, acreage of pine forest type declined 24 percent; the average annual loss was 53,000 acres. Hardwoods replaced pines on at least 35 percent of the acreage harvested and retained in commercial forest between 1966 and 1977.

–volume of growing-stock timber on commercial forest land increased from 16.2 to 19.7 billion cubic feet, or by 22 percent. Although hardwoods accounted for more than 80 percent of the net gain, softwood volume increased 14 percent, reversing the downward trend measured in the 1966 inventory. Pine volume in the Coastal Plain continued to decrease but at a slower rate. The overall volume increase is attributed to a sharp rise in growth and some reduction in removals. Volume of loblolly pine, the primary species featured in timber management, increased less than 10 percent; however, many of the young loblolly plantations are still in the sapling-seedling stage of development. Yellow-poplar increased more than 60 percent in volume and now rivals white oak as the State's most abundant hardwood.

–rate of net annual growth increased 38 percent to an average of 52 cubic feet per acre of commercial forest. Hardwood growth, up 44 percent, accounted for more than three-fourths of the increase. Softwood growth increased 28 percent. By region, average growth per acre ranged from a low of 40 cubic feet per year in the Mountains to a high of 60 cubic feet in the Coastal Plain. In the Piedmont, annual growth averaged 56 cubic feet per acre. Statewide, mortality siphoned off 20 percent of the gross softwood growth. Up to 43 percent of this softwood growth loss was attributed to recent outbreaks of pine bark beetles.

–timber was removed from some 360,000 acres annually through harvesting, intermediate cutting, and forest diversions. This average estimate bridges a decline in annual timber removals over most of the remeasure-

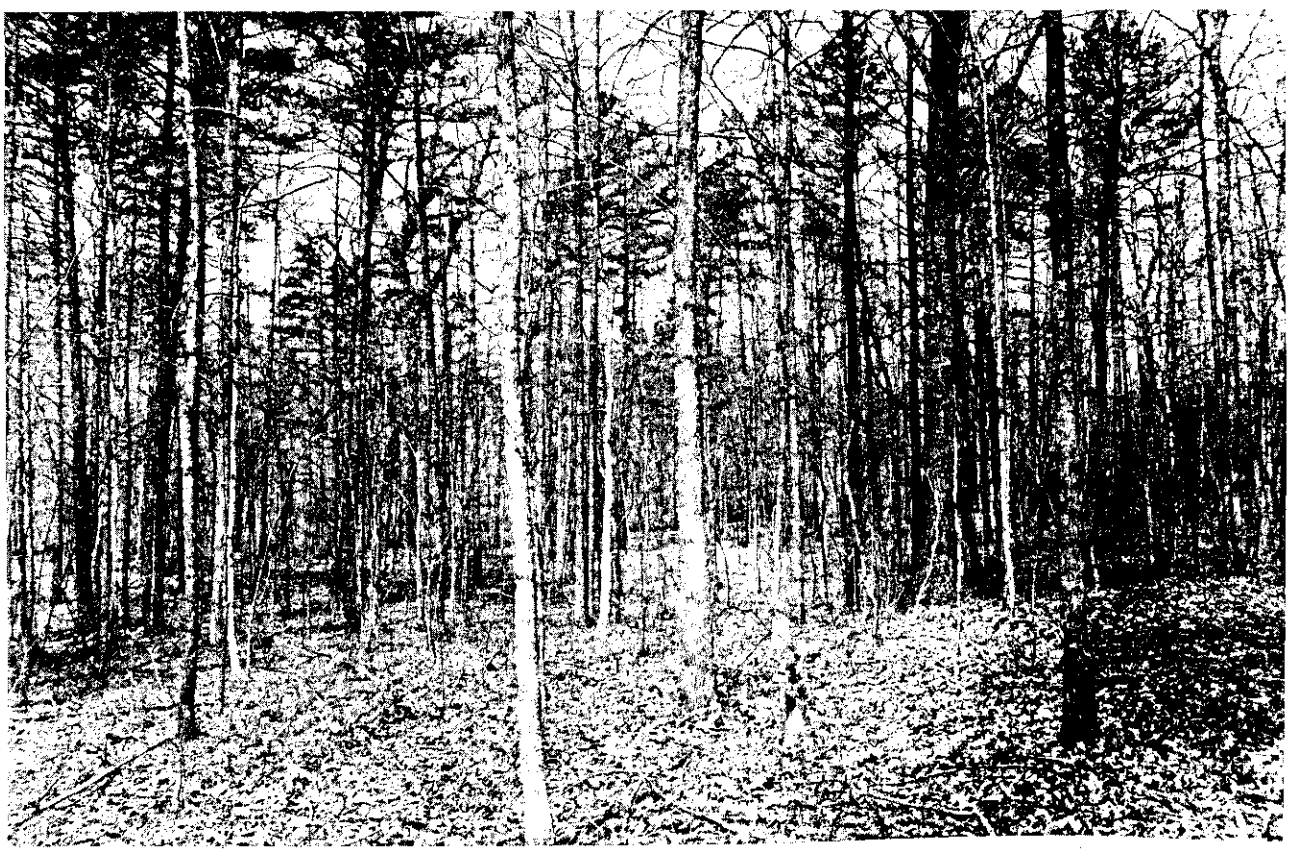
ment period followed by an upturn in recent years. In 1976, removals of growing stock totaled 496 million cubic feet and included 1,680 million board feet of sawtimber. About 77 percent of the cubic volume removed was converted into timber products; 9 percent was left in the woods as logging residues; and the remaining 14 percent was removed in cultural operations, land clearing, and withdrawals where the timber was not used. Closer timber use, both in the woods and at the processing plants, has boosted product output per cubic foot of wood harvested.

–*pulpwood has surpassed saw logs in total product output*. An increase in production of hardwood roundwood and plant byproducts of all species has more than offset a sharp decline in pine roundwood. In 1976, byproducts accounted for 25 percent of the total pulpwood output compared to 17 percent in 1965. While both number of sawmills and annual lumber production declined between 1965 and 1976, saw logs remained the leading roundwood product. After several decades of continuous decline, there seemingly has been an abrupt turnabout in the use of fuelwood.

–*at least 610,000 acres were artificially regenerated.* About 68 percent of this tree planting occurred on forest acres recently harvested. Another 11 percent was on old fields or other nonforest land. The remaining 21 percent of the planting effort occurred on the backlog of poorly stocked forest land. Hardwood encroachment poses a problem in some of these young pine plantations, particularly those established on cutover forest land.

–*there was no significant treatment or disturbance on 11.1 million acres, or 70 percent of the land classified as commercial forest in 1977*. About 23 percent of the undisturbed stands were on sites unfavorable for intensive silvicultural practices either because of steep slopes or year-round water problems. Only 13 percent of the treated or disturbed stands occurred on similar sites.

–*the overall outlook for future timber supplies has improved.* For example, a projection based on the 1966 conditions estimated a prospective available cut of some 755 million cubic feet annually by 1995. A similar projection based on the 1977 conditions suggests a prospective available cut of 840 million cubic feet by 1996, with a further increase to 929 million cubic feet by 2006. Although the pine outlook has improved, hardwoods account for more than 90 percent of the prospective increase.



TIMBER TRENDS

Virginia encompasses 25.5 million acres of land and spans three major physiographic regions: Coastal Plain, Piedmont, and Mountain. The Coastal Plain extends inland about 125 miles to an elevation of 300 feet along its western boundary and contains 25 percent of the land. Major tidal rivers and the Chesapeake Bay divide the northern and central portions of this region into four long peninsulas, one being the Eastern Shore. Although 42 percent of Virginia's population resides in the Coastal Plain, the region is still 64 percent forested.

The Piedmont, with 39 percent of the land, is a gently rolling to hilly plateau extending across the central part of the State between the Coastal Plain and Blue Ridge. Elevations range from 300 feet on the east up to 1,000 feet at the base of the mountains. In width, the region tapers from 150 miles along the North Carolina line, down to 50 miles at the Potomac River. About 37 percent of Virginia's population resides in the Piedmont and is largely concentrated in the north. The Southern Piedmont has the highest proportion of forested land in the State, 67 percent; the Northern Piedmont has the lowest, 61 percent.

The Mountain Region, with 36 percent of the land, has three distinct land formations: the Blue Ridge Mountains on the east, the Appalachian Plateau on the west, and the valley and ridges in between. Within this rugged topography, elevations rise up to 5,700 feet. With only 21 percent of the State's inhabitants, much of the region is sparsely populated. The Northern Mountain Unit is 65 percent forested compared to 63 percent in the Southern Unit, where almost one-fourth of the land is classified as pasture.

This fourth inventory of Virginia's forest resources identified significant differences in recent trends in land use, ownership patterns, forest type, and timber production among the three regions. Also, because of important sectional differences, this analysis retains the traditional divisions of both the Piedmont and Mountain Regions into southern and northern Survey Units (fig. 1).

LITTLE CHANGE IN COMMERCIAL FOREST ACREAGE

Statewide, between 1966 and 1977, area classified as commercial timberland increased from 15.8 to almost 16.0 million acres, or less than 1 percent. Reversion of former agricultural lands to forest, mostly in the Northern Piedmont, and reclassification of some marginal sites on the National Forests in the Mountain Region accounted for most of this small net increase. Acreage of commercial forest land declined slightly in both the Coastal Plain and Southern Piedmont. The Coastal Plain loss reflects the withdrawal of some 50,000 acres in the Dismal Swamp from future timber production.

Prospects for any further increase in acreage available for timber production in Virginia are dim. As in the rest of the Southeast, this primary source of new forest land is gradually drying up. For example, between the 1957 and 1966 inventories, almost 650,000 acres of idle agricultural land in Virginia reverted to forest. Between 1966 and 1977, about 450,000 acres of such land reverted. The 1966 inventory classified 660,000 acres as idle cropland; the 1977 inventory 365,000 acres. Meanwhile, diversions of commercial timberland to other uses continue at the rate of 45,000 acres annually (table I).

In addition to the commercial forest land, almost 445,000 acres in Virginia were classified as noncommercial forest. Timber harvesting is prohibited on 84 percent of this land, and the remaining 16 percent is incapable of producing 20 cubic feet of industrial wood per acre per year because of adverse site conditions. Forests with-

Table I. – Changes in area of commercial forest land, by Survey Unit, Virginia, 1966–1977

Survey Unit	Area of commercial forest land in:		Net change	Changes							
				Total gain	Additions from:		Total loss	Diversions to:			
	1966	1977			Non-forest	Noncommercial forest		Noncommercial forest	Agriculture	Urban and other	Water
	Thousand acres										
Coastal Plain	4,079.3	4,003.5	- 75.8	91.2	87.2	4.0	167.0	55.7	31.8	77.5	2.0
Southern Piedmont	3,789.9	3,778.4	- 11.5	86.0	86.0	–	97.5	–	57.8	37.9	1.8
Northern Piedmont	2,458.9	2,552.1	+ 93.2	171.9	160.8	11.1	78.7	11.3	25.9	31.1	10.4
Northern Mountain	2,503.3	2,625.7	+122.4	190.3	42.9	147.4	67.9	24.4	33.9	9.6	–
Southern Mountain	2,993.0	3,013.1	+ 20.1	96.4	79.6	16.8	76.3	5.1	30.3	38.7	2.2
State	15,824.4	15,972.8	+148.4	635.8	456.5	179.3	487.4	96.5	179.7	194.8	16.4

drawn from timber production within the Shenandoah National Park, the Great Dismal Swamp National Wildlife Refuge, and along the Blue Ridge Parkway account for well over half of the noncommercial forest land. Timber harvesting and other uses are also restricted to varying degrees on the Mount Rogers National Recreation Area and other parts of the Jefferson and George Washington National Forests.

DECLINE IN FARM WOODLAND SLOWS

As in other Southeastern States, transfer of forest ownership in Virginia from farmers to other private owners has been common. Twenty years ago, farmers owned 10.1 million acres, or 65 percent of Virginia's commercial timberland. By 1966, acreage of farm woodland had dropped below 7.0 million acres to 44 percent of the total. Since 1966, the decline has continued but at a slower rate. This latest inventory classified 6.2 million acres, or less than 39 percent of the commercial forest land, as farmer owned. Ownership of much of this acreage has shifted to other miscellaneous private owners who vary greatly in their attitudes toward forest management. Collectively, farmers and other private, nonindustrial landowners still control 12.3 million acres, or 77 percent of the commercial timberland.

Since 1966, forest industries have increased their timberland base to almost 1.7 million acres, or by about 7 percent. Compared with earlier trends, these statistics indicate forest industries have slowed down their acquisition of more land. Between the 1957 and 1966 inventories, they increased their land base from 1.2 to almost 1.6 million acres. Although forest industries own less than 11 percent of the commercial forest land, they control about 25 percent of the acreage of pine forest types.

Almost 2.0 million acres or 12 percent of Virginia's commercial forest land is publicly owned. About three-fourths of this timberland is on the Jefferson and George Washington National Forests, located mainly in the Mountain Region. Other large Federal holdings include the Quantico, A. P. Hill, and Camp Pickett military reservations and forests around the John H. Kerr Reservoir. Collectively, the State, counties, and municipalities control almost 13 percent of the publicly owned timberland. Although changes in forest classification distort the trend, acreage of publicly owned timberland has gradually increased.

HARDWOODS CONTINUE TO REPLACE PINES

Over the years, Virginia has experienced a strong successional trend from pine to hardwood within its commercial timberland. Because of changes in survey procedure, changes in acreage by forest type between 1957 and 1977 provide the best measure of the trend. In 1966, sample plots were allowed to straddle two or more forest conditions. This procedure inflated the estimate of oak-pine type and consequently affected other types. In both the 1957 and 1977 inventories, sample plots were confined to a single condition.

During this 20-year period, acreage of pine type declined 24 percent; the average annual loss was 53,000 acres. During this period, acreage of hardwood type increased almost 15 percent; the average annual increase

was 79,000 acres. A net annual increase of 26,000 acres in commercial forest land accounts for the difference. Since 60 percent of the nonforest acres reverting to forest between 1966 and 1977 came in with pine, the 53,000 acres of net annual loss in pine type is probably a conservative estimate of the rate of hardwood encroachment.

It is still too early to quantify how effective recent pine reforestation efforts have been in curbing the trend toward hardwood. A prime opportunity for regenerating more acreage with pine occurs at time of harvest. Yet, between 1966 and 1977, hardwoods replaced pines on at least 35 percent of the acreage harvested and retained in commercial forest. This process alone accounts for an annual loss of some 24,500 acres of pine forest type.

If all forest types are included, about 2.0 million acres were harvested and retained in commercial forest between 1966 and 1977, excluding thinnings and other intermediate cuttings. When field crews remeasured the sample plots on these cutover lands, pines dominated the stocking on only 24 percent of the acreage. Pines made up at least one-fourth of the stocking on another 14 percent classified as oak-pine forest type. These figures are slightly higher than the pine proportions on all timberlands—a possible sign of progress. For example, pines dominate the stocking on 3.4 million acres, or less than 22 percent of all timberland. Pines make up at least one-fourth of the stocking on another 1.9 million acres, or 12 percent, classified as oak-pine.

The age distribution of the pine stands provides some further evidence of progress in pine regeneration. It indicates, on the average, almost 71,000 acres were successfully regenerated with pine annually during the past decade, compared to only 56,000 acres during the preceding decade. These figures include reversions of idle agricultural lands to pine.

INVENTORY VOLUME UP 22 PERCENT

Between 1966 and 1977, volume of growing-stock timber on commercial forest land increased from 16.2 to 19.7 billion cubic feet, or by 22 percent. Although hardwoods accounted for more than 80 percent of the net gain, softwood volume increased by 14 percent, reversing the downward trend measured in the 1966 inventory. Volume of pine timber in the Coastal Plain continued to decrease, but the rate of loss slowed. The overall volume increase is attributed to a sharp rise in growth and some reduction in removals (fig. 2).

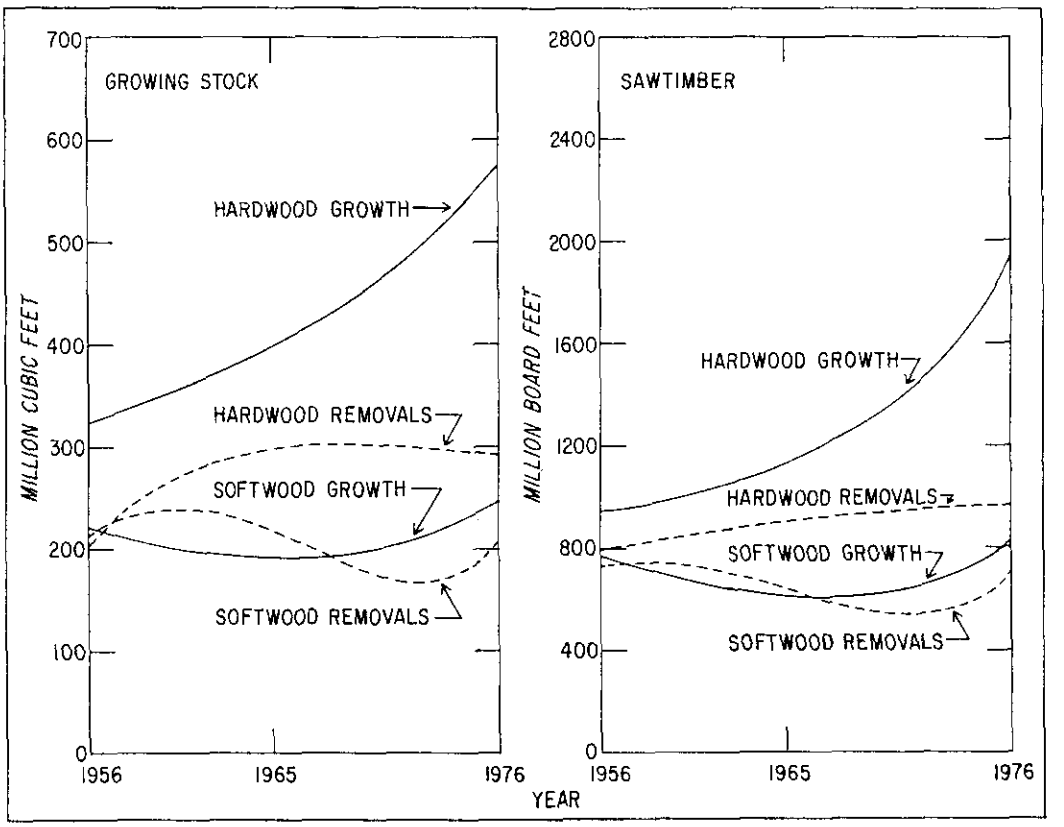


Figure 2. — Trends in net growth and timber removals in Virginia since 1956.

By region, the increase in volume ranged from 4 percent in the Coastal Plain to 33 percent in the Mountains. Volume was up 28 percent in the Piedmont. By ownership, the increase ranged from 5 percent on forest industry lands to 54 percent on National Forests. This small increase for forest industry reflects a rapid conversion of its older natural stands to plantations. Almost 38 percent of its timberland supports young sapling-seedling stands. Sapling-seedling stands occupy less than 12 percent of the acreage on National Forests. Volume was up 20 percent on other private holdings and 40 percent on other public forests.

The volume increases also extended across all tree sizes for both softwoods and hardwoods. The decline in softwood volume between 1957 and 1966 occurred mainly in diameter classes 6 through 12 inches. These diameter classes have now recovered in most of the State. Softwood volume continues to peak in the 8-inch-diameter class, and drops off sharply beyond the 10-inch class (fig. 3). This distribution suggests most pines are cut once they reach these size classes. A similar distribution shows hardwood volume begins to level off at 10 inches, and peaks in the 12-inch-diameter class. Many hardwoods are cut at this size, and volume drops off very sharply beyond 14 inches (fig. 4).

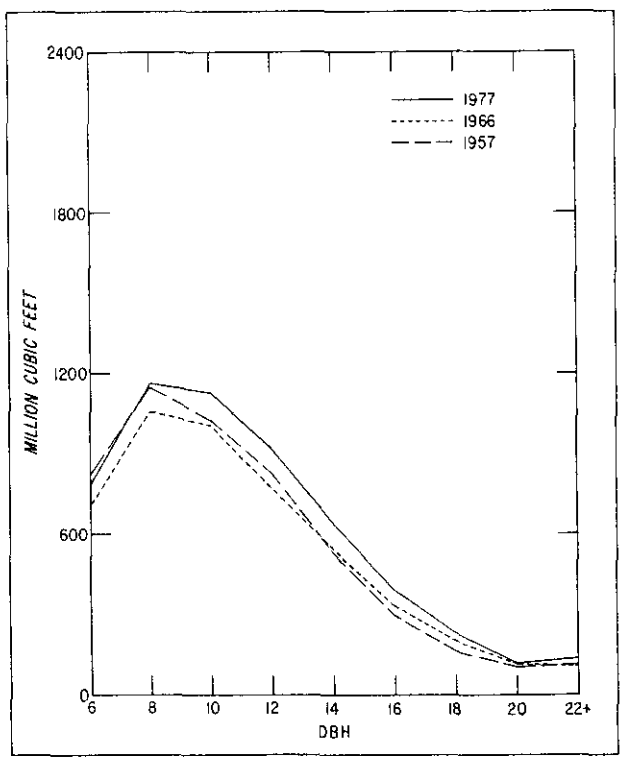


Figure 3. — Volume of softwood growing stock, by tree diameter, 1957, 1966, and 1977.

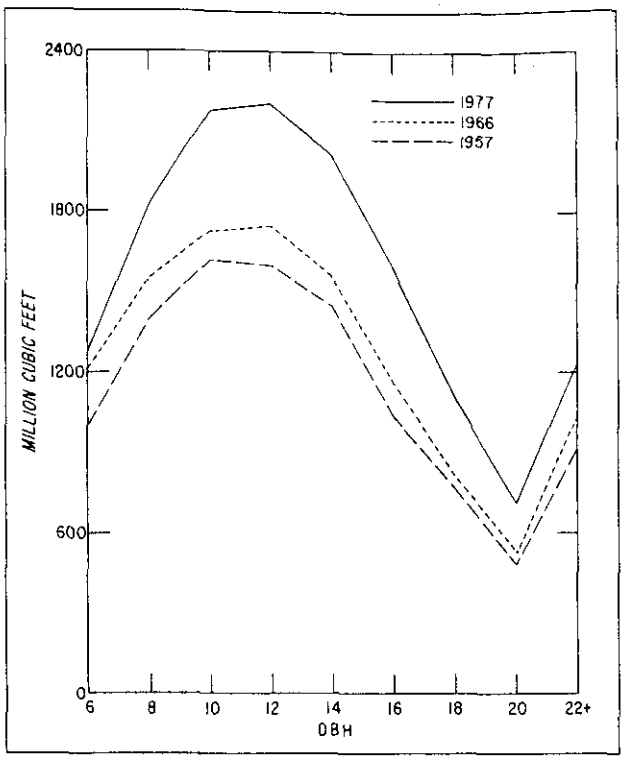


Figure 4. — Volume of hardwood growing stock, by tree diameter, 1957, 1966, and 1977.

The inventory of growing-stock volume includes 53.8 billion board feet of sawtimber, up 25 percent since 1966. By region and ownership, this buildup in sawtimber inventory followed much the same pattern as described for total growing stock. Almost 51 percent of the sawtimber volume is in trees 15.0 inches d.b.h. and larger, compared to 50 percent in 1966 and 48 percent in 1957. About one-fourth of Virginia's timberland supports stands with 5,000 board feet or more per acre.

The inventory also includes 3.5 billion cubic feet of timber in trees failing to qualify as growing stock because of species, poor form, or internal rot. Although these trees are generally unsuitable for saw logs, they contain 15 percent of the volume of all live trees 5.0 inches d.b.h. and larger. About 95 percent of this inferior timber is hardwood.

SPECIES COMPOSITION CHANGES

The species makeup of Virginia's timber resource varies considerably by region. In terms of volume, loblolly pine and Virginia pine are the leading softwood species (fig. 5). Together, they account for almost 70 percent of the softwood growing stock. Loblolly pine

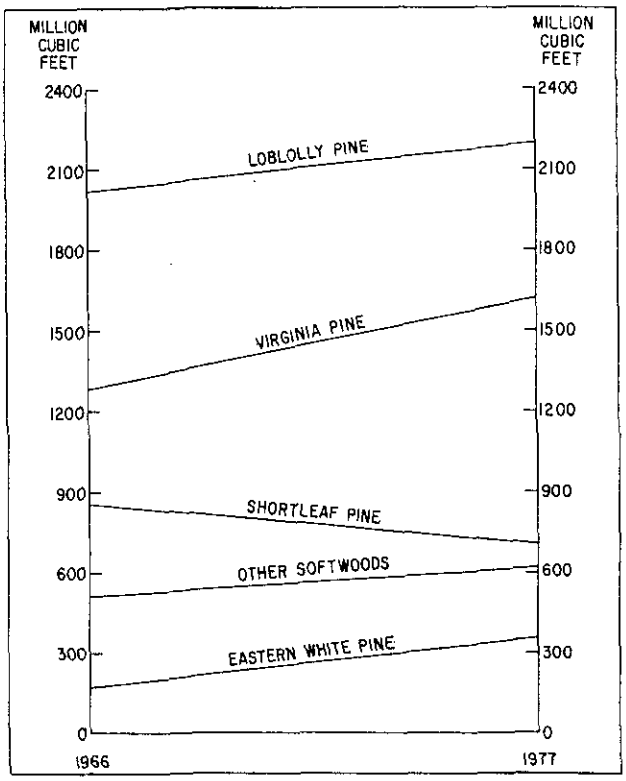


Figure 5. — Change in volume of softwood growing stock, by species, 1966-1977.

predominates in the Coastal Plain and is the primary species featured in timber management. Statewide, volume of loblolly pine has increased less than 10 percent since 1966; however, many loblolly plantations are still in the sapling-seedling stage of development.

Virginia pine is the leading softwood species in the Piedmont and its volume is increasing rapidly. As the pioneer species on much of the agricultural land that has reverted to forest, Virginia pine accounted for half of the net increase in softwood volume between 1966 and 1977. Shortleaf pine volume decreased 17 percent over the same period; its volume is declining throughout most of the Southeast.

In the Mountain Region, pitch pine is the leading softwood species in the Northern Unit, and eastern white pine predominates in the Southern Unit. Statewide, volume of eastern white pine more than doubled between 1966 and 1977.

Hardwoods continue to dominate the species composition in each of the three physiographic regions. In the Coastal Plain, white oak and sweetgum are the most prevalent hardwood species in terms of timber volume. In the Piedmont, yellow-poplar and white oak are the leading hardwoods. Among a variety of oaks and other hardwoods, chestnut oak and yellow-poplar are the most abundant species in the Mountain Region.

Statewide, all of the major hardwood species except blackgum and tupelo increased in volume since 1966 (fig. 6). Volume of blackgum and tupelo declined 15 percent. Of all the hardwood species, yellow-poplar is increasing fastest. Up more than 60 percent in volume since 1966, yellow-poplar now rivals white oak as the State's most abundant hardwood. Collectively, the wide variety of oaks still account for slightly more than half of the total hardwood growing stock.

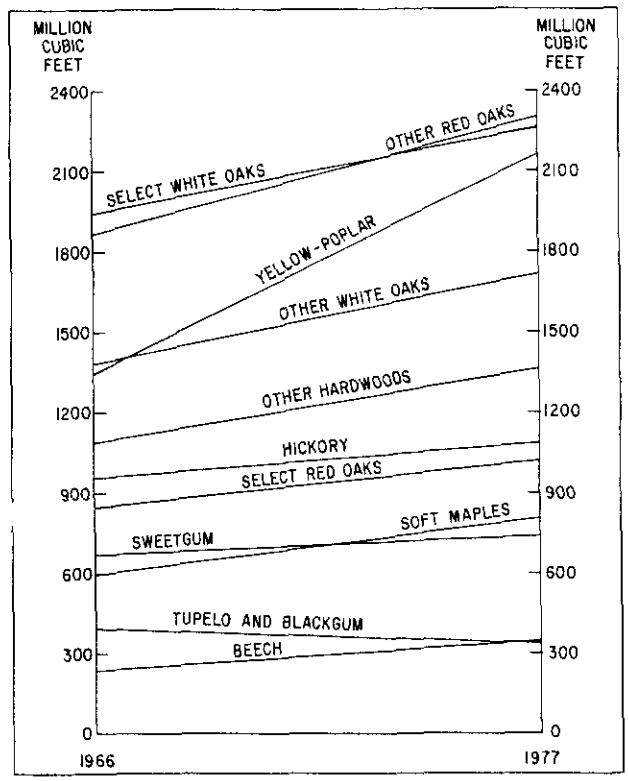


Figure 6. — Change in volume of hardwood growing stock, by species, 1966-1977.

GROWTH RATE UP 38 PERCENT

In 1976, net growth of growing-stock timber averaged 52 cubic feet per acre of commercial forest land, or 38 percent above the adjusted growth rate in 1965. Hardwood growth was up by 44 percent and accounted for more than three-fourths of the total increase. Softwood growth increased 28 percent. During the latter part of the 11 years between measurements,

pine bark beetles caused extensive mortality in Virginia's forests. Statewide, mortality siphoned off 20 percent of the softwood growth. Up to 43 percent of this softwood growth loss was attributed to the beetle outbreaks.

By region, average annual growth per acre ranged from a low of 40 cubic feet in the Mountains to a high of 60 cubic feet in the Coastal Plain. In the Piedmont, growth averaged 56 cubic feet per acre. Older hardwood stands, together with the relatively high proportion of poor sites, explain the low growth rate in the Mountain Region. The high growth rate in the Coastal Plain reflects considerable effort in more intensive timber management and the relatively high proportion of good sites. More than half of the State's pine plantations have been established in this region. The greatest gain in growth rate, more than 60 percent, occurred in the Piedmont. Here, the statistics reflect the development of many young pine stands established on retired agricultural lands. In the Piedmont, ingrowth of saplings into the poletimber-size class accounted for 23 percent of the gross softwood growth, compared to only about 14 percent in the other regions.

By ownership class, average growth per acre ranged from a low of 38 cubic feet on the National Forests, up to 63 cubic feet on other public forests. Again, the low growth rate on National Forests is attributed to the prevalence of older hardwood stands and poor sites. On forest industry lands growth averaged 57 cubic feet per acre, compared to 52 cubic feet on other private holdings. A high proportion of sapling-seedling stands tended to pull the industry average down. Within the other private owner classes, the growth rate was slightly higher on farm than on the nonfarm holdings.

A detailed breakdown of gross growth into its various components, by Survey Unit and species group, along with the distribution of mortality and removals, indicates the sources of annual change in timber volume (table II). Survival growth, the volume increment on

Table II. – Annual components of change in the volume of growing stock on commercial forest land, by Survey Unit and by softwood and hardwood, Virginia, 1976

Survey Unit and species group	Gross growth	Components of growth					Mortality	Net growth	Removals	Net change
		Survivor growth	Ingrowth	Growth on ingrowth	Growth on removals	Growth on mortality				
	Million cubic feet									
Coastal Plain:										
Softwood	128.9	107.7	16.5	1.8	2.1	0.8	25.4	103.5	111.6	- 8.1
Hardwood	146.8	128.5	15.2	1.2	1.7	0.2	10.0	136.8	95.6	+ 41.2
Total	275.7	236.2	31.7	3.0	3.8	1.0	35.4	240.3	207.2	+ 33.1
Southern Piedmont:										
Softwood	94.1	70.7	19.9	1.6	1.3	0.6	19.7	74.4	57.4	+ 17.0
Hardwood	152.8	134.0	15.4	1.6	1.6	0.2	12.2	140.6	75.1	+ 65.5
Total	246.9	204.7	35.3	3.2	2.9	0.8	31.9	215.0	132.5	+ 82.5
Northern Piedmont:										
Softwood	46.6	34.9	10.2	0.7	0.6	0.2	8.8	37.8	24.9	+ 12.9
Hardwood	115.0	101.2	11.7	0.8	1.1	0.2	11.6	103.4	57.4	+ 46.0
Total	161.6	136.1	21.9	1.5	1.7	0.4	20.4	141.2	82.3	+ 58.9
Northern Mountain:										
Softwood	19.1	15.9	2.8	0.2	0.1	0.1	5.3	13.8	6.8	+ 7.0
Hardwood	89.8	79.2	9.3	0.8	0.3	0.2	9.1	80.7	26.1	+ 54.6
Total	108.9	95.1	12.1	1.0	0.4	0.3	14.4	94.5	32.9	+ 61.6
Southern Mountain:										
Softwood	20.7	17.7	2.6	0.2	0.1	0.1	3.0	17.7	4.5	+ 13.2
Hardwood	129.0	112.2	15.0	1.0	0.5	0.3	14.5	114.5	36.6	+ 77.9
Total	149.7	129.9	17.6	1.2	0.6	0.4	17.5	132.2	41.1	+ 91.1
State:										
Softwood	309.4	246.9	52.0	4.5	4.2	1.8	62.2	247.2	205.2	+ 42.0
Hardwood	633.4	555.1	66.6	5.4	5.2	1.1	57.4	576.0	290.8	+285.2
Total	942.8	802.0	118.6	9.9	9.4	2.9	119.6	823.2	496.0	+327.2

growing-stock trees 5.0 inches d.b.h. and larger in the inventory at the beginning of the year and surviving to its end, accounted for 85 percent of gross growth. Ingrowth, the net volume of growing-stock trees reaching 5.0 inches d.b.h. during the year, and the subsequent growth on these trees, accounted for another 14 percent. Growth on removals before removal, and growth on mortality before death made up the remaining 1 percent.

In 1976, mortality of growing stock totaled almost 120 million cubic feet and reduced gross growth by 13 percent. Although hardwoods exceeded softwoods in stocking, inventory volume, annual growth, and volume removed, softwoods accounted for slightly more than half of the mortality. The mortality of pine caused by bark beetles explains this exception. The annual insect kill also included more than 80 million board feet of pine sawtimber.

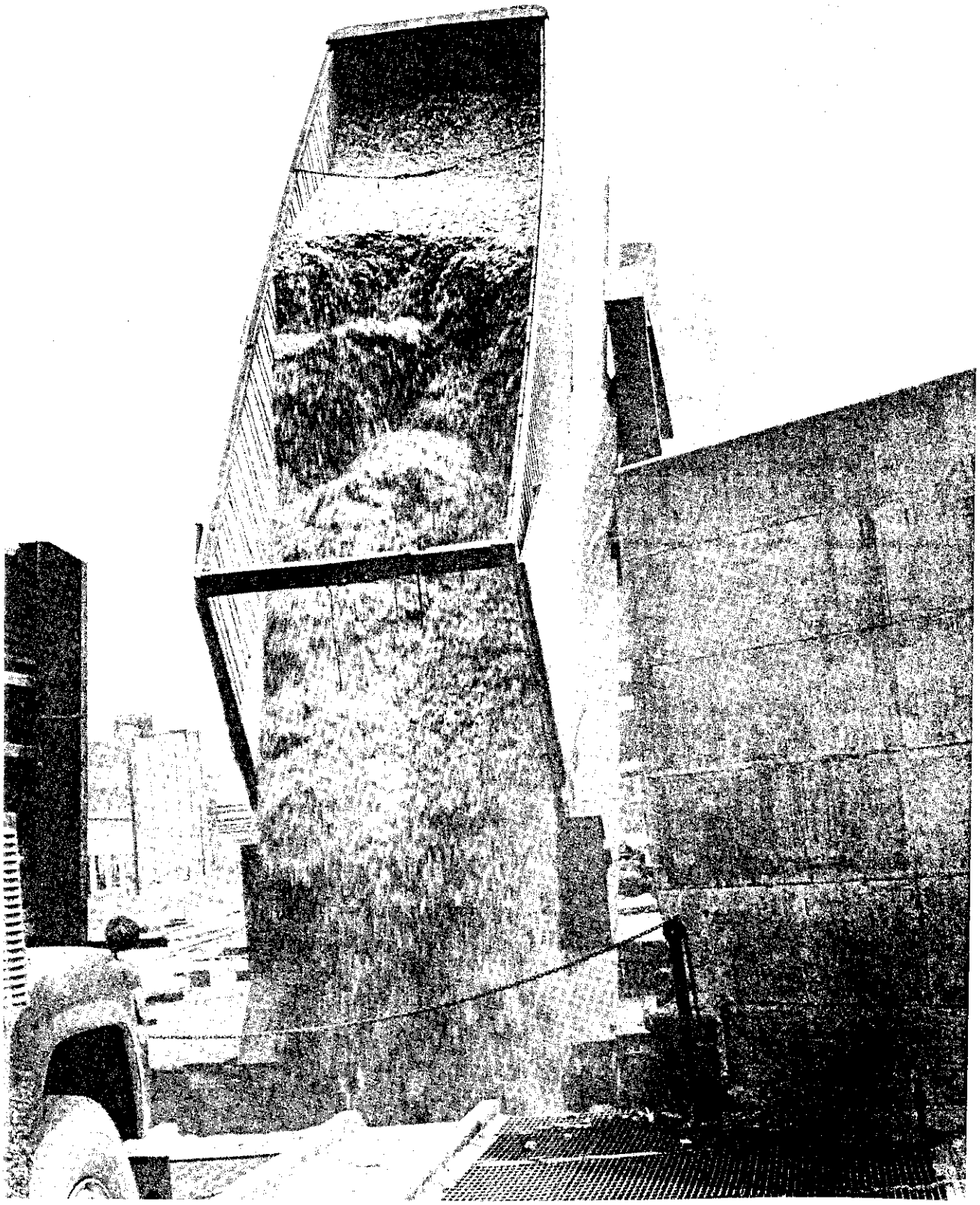
For both softwoods and hardwoods, relatively little of the mortality was attributed to wildfire. With all of its land under protection, Virginia has one of the most successful fire control records in the South. Over the entire remeasurement period, acreage burned averaged less than 10,000 acres per year (table III).

Table III. – Area under fire protection, protected area burned, number of fires, and average size of fires, Virginia, 1966-1976[1]

Year	Area protected[2]		Protected area burned		Fires	Average size of fires
	M acres	*Percent*	*M acres*	*Percent*	*Number*	*Acres*
1966	15,711	100	9	0.06	2,149	4
1967	16,172	100	14	0.09	1,970	7
1968	16,187	100	11	0.07	2,779	4
1969	16,206	100	11	0.07	1,990	6
1970	16,204	100	12	0.07	1,893	6
1971	16,222	100	17	0.10	1,716	10
1972	16,173	100	2	0.01	792	3
1973	16,215	100	4	0.02	976	4
1974	20,457	100	9	0.04	2,942	3
1975	20,508	100	5	0.02	2,467	2
1976	20,517	100	15	0.08	5,677	3

[1] Source: U.S. Department of Agriculture, Forest Service, Wildfire Statistics, 1966-1976.

[2] Includes forest and nonforested watershed lands.



TIMBER PRODUCTS OUTPUT

Results from three separate studies were merged to estimate the output of timber products in Virginia for 1976: (1) The remeasurement of permanent sample locations provided the estimates of total timber removals. (2) Felled trees were measured at a sample of active harvesting operations to develop utilization factors for each of the roundwood products. (3) All primary wood-using plants were canvassed to obtain information on wood receipts, byproducts, and wood residues. Based on these studies, volume of roundwood harvested in Virginia totaled about 464 million cubic feet. The estimate of total timber products output includes an additional 64 million cubic feet of plant byproducts, such as chipped residues used for pulpwood and veneer cores used to manufacture lumber. Altogether, timber products output totaled about 528 million cubic feet.

The canvass of primary wood-using industries showed that 486 mills operated in Virginia during 1976 (fig. 7). These mills received logs, bolts, and other forms of roundwood from which they manufactured lumber, veneer, plywood, chips, pulp, paper, and other products. In addition, an undetermined number of secondary manufacturing plants located within the State were engaged in the remanufacture of these products into finished goods such as furniture, fixtures, and containers. Altogether, the forest products industry in Virginia employs more than 60,000 people and generates an annual payroll of more than $500 million.

SAW LOGS ACCOUNT FOR MORE THAN 40 PERCENT OF TOTAL ROUNDWOOD OUTPUT

Although both number of sawmills and annual lumber production declined between 1965 and 1976, saw logs remained the leading roundwood product harvested and accounted for more than 40 percent of the 1976 roundwood output. Number of active sawmills decreased from 870 to 452. Based on Bureau of the Census figures, annual lumber production fluctuated between a high of 1,179 million board feet in 1966 and a low of 867 million board feet in 1975 (fig. 8). This same source showed production back up to 944 million board feet in 1976.

Based on the International ¼-inch log rule, volume of saw logs harvested in Virginia during 1976 exceeded 1,013 million board feet. The solid-wood content of these logs exceeded 189 million cubic feet. Hardwood species provided 58 percent of the saw-log output and softwood species provided 42 percent. These figures still identify considerable imbalance between product output and the species makeup of the timber inventory. Hardwoods make up 70 percent of Virginia's sawtimber inventory and account for 70 percent of the annual sawtimber growth, but they provide less than 60 percent of the saw-log harvest.

PULPWOOD HAS SURPASSED SAW LOGS IN TOTAL PRODUCT OUTPUT

Although saw logs remain the leading roundwood timber product harvested in Virginia in terms of volume, pulpwood has surpassed saw logs in total output when pulped plant residues are included. In 1976, the round pulpwood harvest totaled 149 million cubic feet; however, other wood-using plants within the State produced another 50 million cubic feet of pulpwood in the form of chips and other byproducts. Based on these figures, byproducts accounted for one-fourth of the total pulpwood output, compared to 17 percent in 1965. This improved utilization, together with an increase in use of hardwood for pulp fiber, helped ease the demand on Virginia's pine timber supplies.

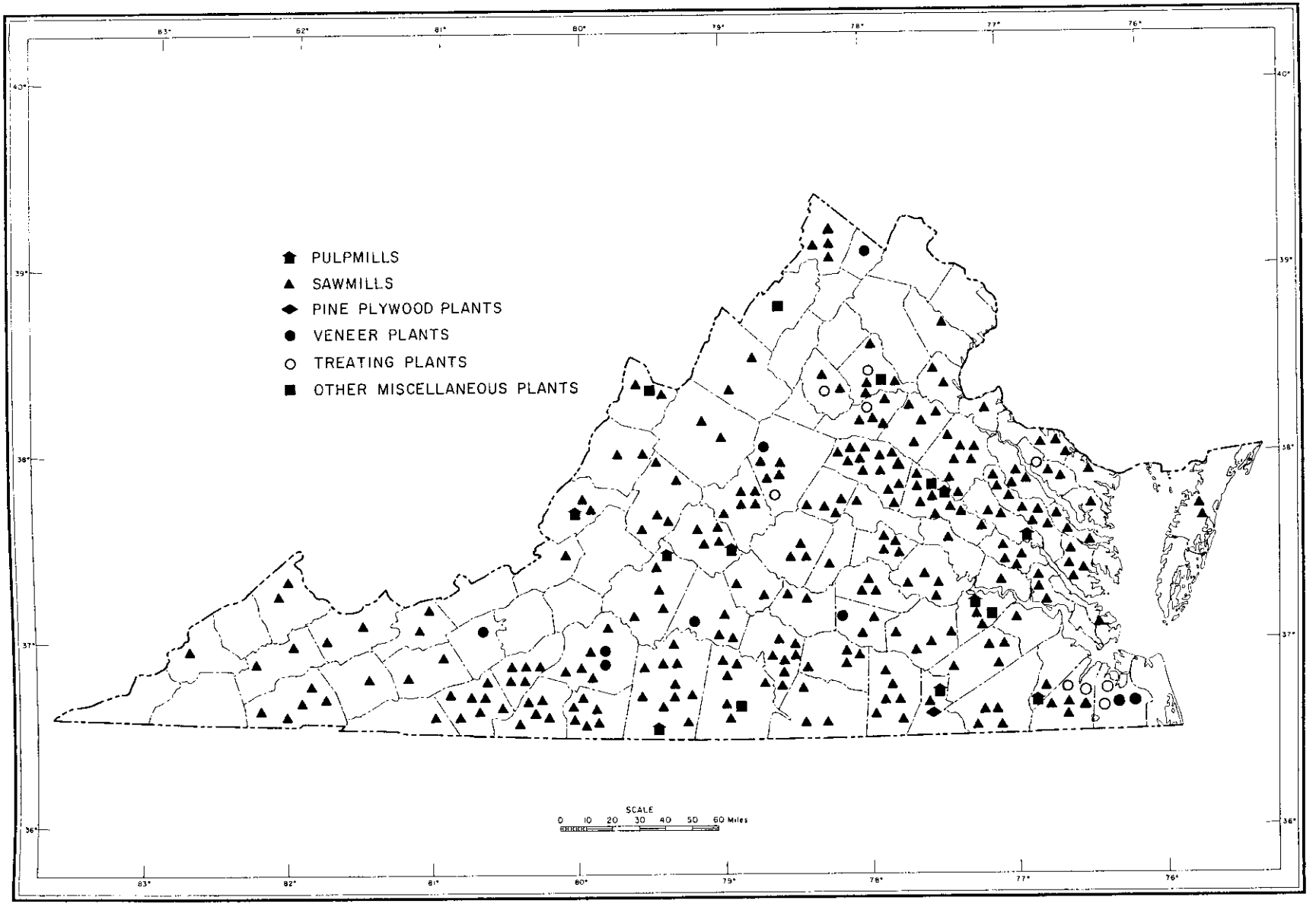


Figure 7. – Location of primary wood-using industries in Virginia, 1976.
(Sawmills producing less than a million board feet are excluded.)

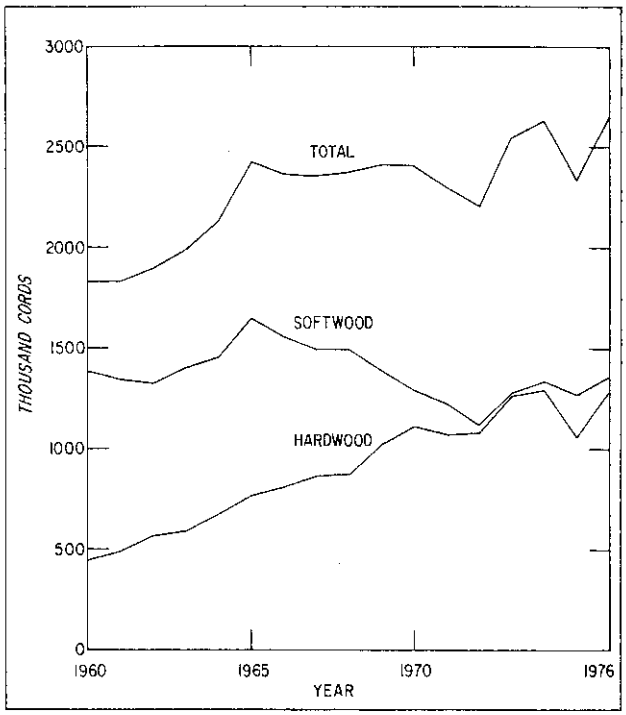


Figure 8. — Lumber production in Virginia, 1960-1976.

Between 1965 and 1972, annual output of softwood pulpwood decreased from the equivalent of 1,650,900 cords down to 1,121,100 cords, or by 32 percent. Since 1972, softwood production has again been on the increase, reaching the equivalent of 1,366,100 cords in 1976. Over this same 11-year period, annual output of hardwood pulpwood increased from 770,100 cords to a record high of 1,295,700 cords in 1976, or by 68 percent (fig. 9). All of these figures include both roundwood and byproducts.

Although the total 1976 pulpwood production figures in this report agree with the Virginia figures published in Resource Bulletin SO-66, "Southern Pulpwood Production, 1976," differences are acknowledged in the breakdown between roundwood and byproducts. With the upward surge in number and kinds of chipping operations, it has become increasingly difficult to maintain a clear separation between volume of roundwood and volume of byproducts. Results from the more complete industry canvass provided higher and more accurate measures of roundwood chipped.

Even with the increased use of hardwood for pulpwood, the strong demand for pine continues to be strong relative to the species composition in Virginia's forest. For example, 75 percent of the volume of all live timber is hardwood; yet, hardwoods provided only about 50 percent of the round pulpwood harvest in 1976. The pulp industry's need for long fiber limits its increased use of the more abundant hardwood timber supplies. Attention is also called to the estimated 180 million board feet of sawtimber removed as part of the 1976 pulpwood harvest. Nearly 60 percent of this sawtimber used for pulpwood was softwood.

Based on the interstate movement in 1976, Virginia is a net importer of round pulpwood. Nine pulpmills, with a combined daily pulping capacity of 7,158 tons,

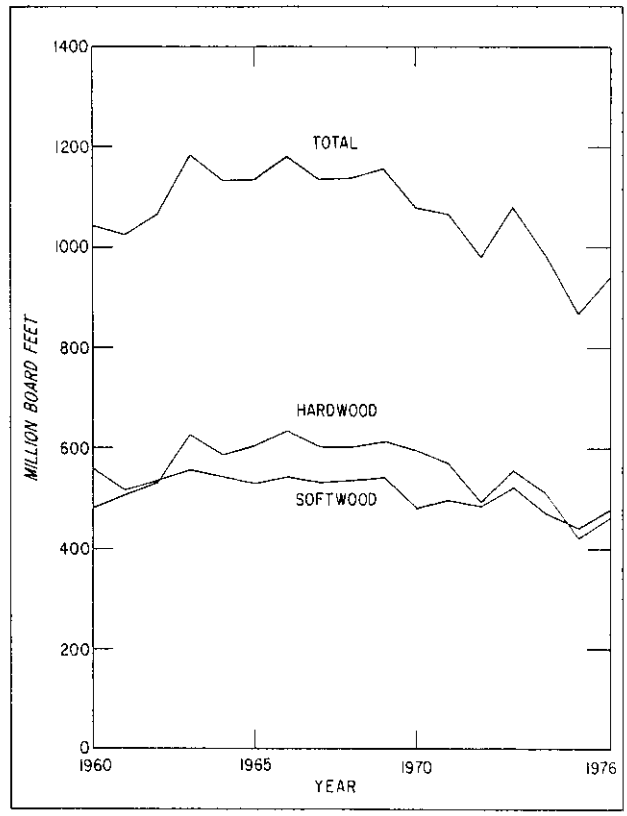


Figure 9. — Pulpwood production in Virginia, including byproducts, 1960-1976.

operated in the State during 1976. Based on the reported sources of roundwood received at these mills, 73 percent came from Virginia, while the remaining 27 percent was brought in from North Carolina and other States. Only 11 percent of the round pulpwood cut in Virginia was transported to mills outside the State. Virginia's pulp industry imported almost 3 cords of roundwood for each cord exported. With expansion projects already underway to increase pulping capacities at some of the existing mills plus announced plans for the construction of one new mill, producers will likely look to Virginia's timberland for a greater quantity of pulpwood.

ERRATA

Knight, Herbert A., and Joe P. McClure
1978. Virginia's timber, 1977. U.S. Dep. Agric. For. Serv., Resour. Bull. SE-44, 53 p. Southeast. For. Exp. Stn., Asheville, N.C.

Page 15. The two drawings on this page have been misplaced and should be reversed. Thus, the drawing in the first column, which shows pulpwood production, should appear over the caption in the second column, and the drawing in the second column should appear over the caption in the first column.

Page 24. The last line of the first complete paragraph should read 360,000 acres rather than 360 acres.

OUTPUT OF PEELER LOGS UP

The timber products output studies measured a further decline in the harvest of hardwood veneer logs; however, the total output of peeler logs was up. An increase in the output of pine peeler logs accounted for the total gain. In 1965, Virginia's first pine plywood plant was just coming on stream. While there is still only one major pine plywood plant in the State, volume of softwood peeler logs harvested in 1976 exceeded 8 million cubic feet—more than three times greater than the output of hardwood peeler logs. Altogether, output of veneer logs totaled 11 million cubic feet and accounted for only 2 percent of total roundwood output. The industry canvass identified nine hardwood veneer plants in Virginia. In 1976, the State was a net importer of both softwood and hardwood veneer logs.

OUTPUT OF OTHER INDUSTRIAL PRODUCTS DOWN

In 1976, the combined roundwood output for poles, piling, posts, cooperage bolts, particleboard furnish, and other miscellaneous industrial products totaled about 7 million cubic feet. Additional plant byproducts used primarily for particleboard pushed total output up to almost 12 million cubic feet. In 1965, the comparable combination of these timber products totaled about 19 million cubic feet.

The imbalance between the species composition of Virginia's timber inventory and the species source of its major timber products also shows up in these minor products. In 1965, the source of these minor products was divided about equally between softwoods and hardwoods. In 1976, softwoods provided almost 60 percent of their total output.

FUELWOOD OUTPUT REVERSES ITS HISTORIC DECLINE

After several decades of continuous decline based on the best information available, the 1976 output data indicate an abrupt turnabout in the use of fuelwood. With shortages and rampant increases in the prices of conventional fuels, homeowners and industries alike are again turning to wood to supplement or replace other sources of fuel. While the role of wood in helping to alleviate the energy problem is still uncertain, wood as a renewable resource offers considerable potential in States like Virginia.

Because of the large number of users of relatively small amounts of fuelwood, both the total quantity and source of fuelwood are difficult to measure. The determination of total timber removals from the remeasurement of permanent sample plots, the utilization study, and information obtained from the canvass of primary wood-using plants ensure a reasonable accuracy for the fuelwood estimates.

Surpassed by only saw logs and pulpwood in terms of volume, fuelwood strengthened its position as the State's third leading timber product in 1976. Fuelwood output totaled almost 113 million cubic feet, plus an additional 7 million cubic feet of plant byproducts used for industrial fuel. When combined, this total output was nearly double the 1965 estimate.

A breakdown of the 1976 output by source contradicts any conception that growing-stock trees are not used for fuelwood. Plant byproducts accounted for only 10 percent of the nearly 120 million cubic feet of total output. Rough, rotten, and dead trees together with saplings, tops, limbs, and trees cut from nonforest land accounted for another 34 percent. More than half of the total output came from trees 5.0 inches and larger meeting minimum standards for growing stock. In all of these figures, bark volume is excluded. About two-thirds of the growing stock used for fuelwood was hardwood.

TIMBER USE IMPROVES

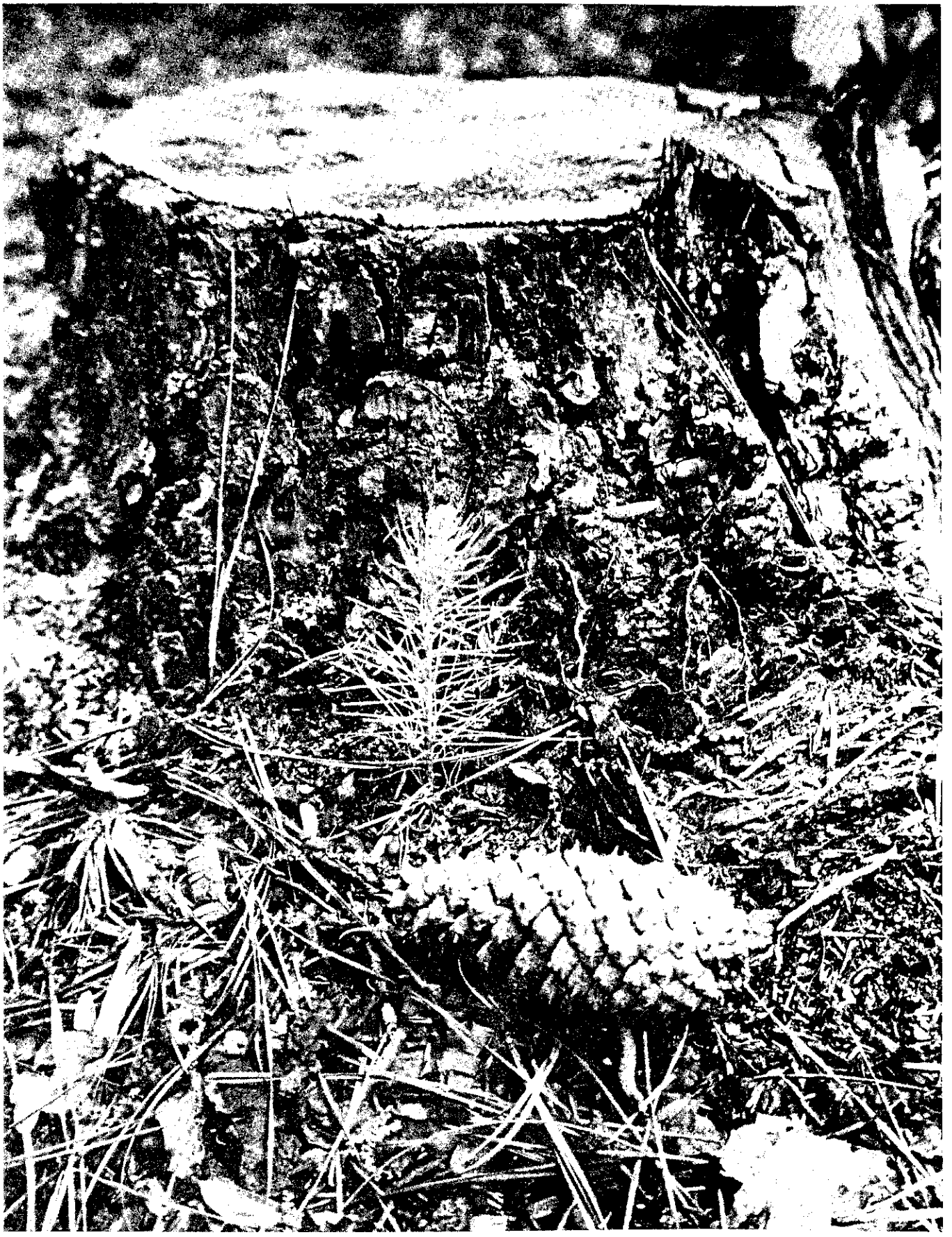
Reductions in logging residues and plant residues, plus an increase in the use of material other than growing stock, indicate substantial improvement in timber use. These actions extend existing timber supplies. For example, the harvest of almost 464 million cubic feet of roundwood products in 1976 resulted in the removal of only 428 million cubic feet of growing stock based on the merchantability standards applied in the inventory. In 1976, less than 47 million cubic feet of logging residues were left in the woods, compared to more than 75 million cubic feet in 1965. Almost 18 percent of the roundwood output came from rough, rotten, and dead trees and other material outside the merchantability standards for growing-stock volume. In 1965, only 10 percent of the roundwood output came from these sources. The salvage of dead timber killed by pine bark beetles, plus the greater use of fuelwood, accounts for part of the increased output from these sources.

Based on information collected in the industry canvass, primary wood manufacturing plants in Virginia generated 19 million cubic feet of unused wood residues in 1976, compared to an estimated 50 million cubic feet in 1965. These figures suggest almost 80 percent of all wood residues generated at Virginia's primary wood manufacturing plants in 1976 were subsequently used, compared to less than 50 percent in 1965. In the Coastal

Plain, where more than half of the plant wood residues were generated in 1976, the use rate was nearly 90 percent. More than 45 percent of unused residues were generated at plants located in the Piedmont where the use rate was a little better than 70 percent. About two-thirds of the residue volume generated in the Mountain Region was used. For the State as a whole, fine material such as sawdust, shavings, and veneer clippings accounted for almost three-fourths of the unused wood residues. All of these residue estimates exclude bark. Nearly 80 percent of the bark residue generated at primary wood manufacturing plants was also used, mainly as industrial fuel.

In addition to the 428 million cubic feet of growing stock cut during the harvesting of roundwood products, another 68 million cubic feet were removed from the inventory by cultural operations, land clearing, and other changes in land use. This unused material is called other removals. About 55 percent of this volume was actually removed or destroyed during cultural operations and land clearing. The remaining 45 percent was in trees still standing on lands removed from commercial forest. Shade trees left standing around new homesites and developments are typical examples of the latter kinds of removals. To avoid distortions of trends in timber removals, timber on major withdrawals, such as the Dismal Swamp, is excluded from the estimates of other removals. In contrast to the reductions in logging residues and plant residues, volume of other removals more than doubled since 1965.

Altogether, volumes of logging residues, plant residues, and other removals totaled 134 million cubic feet in 1976, compared to more than 157 million cubic feet in 1965. In both years, more than 70 percent of this unused material was hardwood.



TIMBER SUPPLY OUTLOOK

Except for possible gains from improved utilization and protection, timber supplies available over the next decade or longer have been determined by actions already taken or foregone. Over a longer period, timber supplies can be increased to the limits established by the growth potential of lands available for timber production. The primary objective in this chapter of the analysis is to bracket future estimates of timber supplies between a *prospective* available cut—the amount available if past trends are extrapolated for 30 years—and a *potential* available cut—the amount attainable through improved timber management. Since softwoods and hardwoods were projected separately, four different projections were made using the Timber Resource Analysis System (TRAS) computer program. The results should not be misinterpreted as bold forecasts; they are reasonable estimates of timber supplies if the stated assumptions hold true.

ACREAGE OF TIMBERLAND WILL LIKELY DECREASE

With a continued buildup in stocking, both volume and growth of timber per acre will increase over the next 30 years. Past trends, however, point to a probable decrease in acreage of timberland. As stated earlier, the acreage of idle agricultural land, the primary source of new forest land, is declining rapidly. The reversion of this idle agricultural land to forest cannot be expected to offset the diversions of commercial forest land to other uses beyond the next decade. Based on the extrapolation of these trends, no significant reduction in acreage of timberland was assumed for the first decade. Between 1986 and 2006, however, the projections reflect an assumed reduction of 600,000 acres.

Aside from the likely decrease in total acreage, it will become increasingly difficult to sustain pine on 20 to 25 percent of the timberland. As forest industries complete their conversions of suitable sites to pine plantations and the reversion of idle agricultural lands to pine diminishes, the decline in pine acreage could accelerate rapidly. To prevent this possible decline, each acre of pine harvested should be regenerated with pine.

TIMBER REMOVALS WILL GRADUALLY INCREASE TO EQUAL GROWTH

Net annual growth provides a maximum estimate of the amount of cut that can be sustained without depleting the inventory. In the projections of timber supplies, growth and mortality rates as determined in this latest inventory were retained throughout the 30-year period. If removals are gradually increased to equal growth, results indicate net annual growth will increase from 52 to 60 cubic feet per acre. When the acreage assumptions are superimposed onto these results, *prospective* annual cut increases from 496 to 929 million cubic feet, including 3,264 million board feet of sawtimber.

HARDWOODS DOMINATE PROSPECTIVE SUPPLY

With the stated assumptions, hardwoods account for more than 90 percent of the prospective increase in available cut (fig. 10). By the end of the projection period, hardwoods would provide 75 percent of the annual removals, compared to 49 percent in 1956, 58 percent in 1965, and 59 percent in 1976. Additional hardwood markets would be required to accommodate this prospective increase in hardwood timber supplies. In light of the growing concern over energy sources, a renewed use of wood for fuel could provide an outlet for substantial quantities of poor-quality hardwoods.

Some users of this information may need to discount the prospective supply of hardwood. For example, nearly one-fourth of the existing acreage occupied with

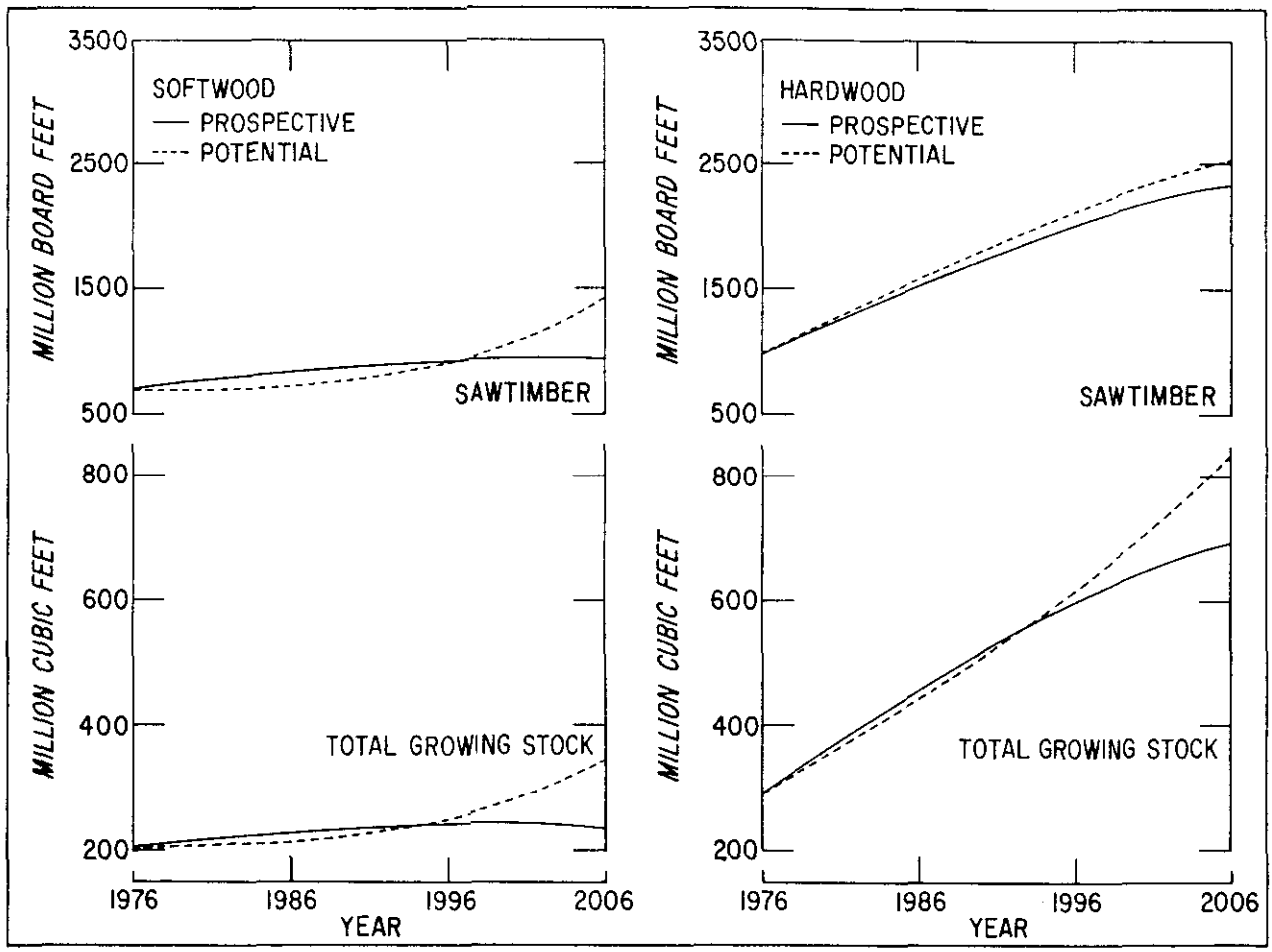


Figure 10. — Prospective and potential available cut, Virginia, 1976-2006.

hardwood types occurs either on slopes 40 percent or steeper or in areas with year-round water problems. It seems reasonable to assume this proportion will hold over the projection period. To harvest timber off these sites often requires special logging techniques.

PINE PLANTATIONS WILL PROVIDE MOST OF THE AVAILABLE SOFTWOOD

In contrast to the abundant hardwood supply, the prospective supply of softwoods will accommodate only a modest increase in cut over the next 30 years. Pine plantations will provide an increasing share of the softwood cut. Most of the pine plantations in Virginia were established after the 1965 inventory identified a pine growth deficit. Pine plantations now account for about 60 percent of all softwood stands less than 10 years old. Timber will start to come from these plantations in the 1990's.

Two separate and independent estimates of plantation acreage are presented in this analysis. First, based on annual reports of forest planting and seeding compiled by the U.S. Department of Agriculture Forest Service, an average of 77,500 acres was planted annually during the remeasurement period (table IV). Second, based upon the field crews' determination of stand origin at each sample location visited in this latest inventory, an average of 55,500 acres had been planted annually (table V). Since some planting efforts fail because of poor survival, mortality, and inadequate site preparation, the first estimate must be discounted. On the other hand, the second estimate is probably conservative since some planted stands are difficult to recognize on the ground. By using the average of the two estimates, one might conclude that some 66,500 acres of plantations will start feeding into the prospective softwood supply annually during the last decade of the projection period.

With an assumed average yield of 3,000 cubic feet per acre at 30 years of age, the annual harvest of 66,500

Table IV. – Acres of forest planting,[1] by ownership class, Virginia, 1966–1976

Fiscal year	Ownership class				All ownerships	Accumulative total
	National Forest	Other public	Forest industry	Other private		
	Acres					
						[2] 525,669
1966	2,418	1,707	35,039	25,603	64,767	590,436
1967	2,748	1,412	43,963	26,797	74,920	665,356
1968	2,038	904	36,636	24,590	64,168	729,524
1969	2,006	1,286	41,381	25,706	70,379	799,903
1970	1,364	1,387	38,493	27,461	68,705	868,608
1971	1,804	2,472	35,072	32,539	71,887	940,495
1972	2,157	2,833	39,750	53,087	97,827	1,038,322
1973	1,511	3,966	30,419	47,559	83,455	1,121,777
1974	1,530	2,303	27,338	51,618	82,789	1,204,566
1975	1,407	2,449	24,849	59,218	87,923	1,292,489
1976	1,696	2,294	26,426	55,497	85,913	1,378,402

[1] Includes acres of planting by direct seeding. Source: U.S. Department of Agriculture, Forest Service, *Forest Planting, Seeding, and Silvical Treatments in the United States.*

[2] Accumulative total prior to FY 1966.

acres of pine plantations could account for up to 85 percent of the prospective available softwood cut. If hardwoods are included, natural stands would still be providing almost 80 percent of available cut.

Distribution of the acres planted by region suggests 52 percent of the prospective increase in timber supplies from plantations will occur in the Coastal Plain. Another 43 percent of the planting occurred in the Piedmont, and the remaining 5 percent was in the Mountain Region (table V). Statewide, about 55 percent of the pine plantations were located on lands owned or leased by forest industries. Another 44 percent occurred on other private lands, and the remaining 1 percent was on public holdings (table VI). Since most of the artificial reforestation in Virginia has been pine, the acreage difference between table V and table VI calls for an explanation. Because of poor survival and inadequate site preparation, hardwoods had encroached on some 195,000 acres with evidence of planting, to the extent that either an oak-pine or other hardwood forest type was assigned. The inventory data indicate the problem of hardwood encroachment is more serious in plantations established on cutover forest land than in plantations established on old fields. For example, hardwood stocking exceeded pine in 25 percent of the plantations established on cutover forest land during the 11-year remeasurement period. Hardwood stocking exceeded pine in less than 10 percent of the plantations established on old fields. On the average, these determinations were made some 5 to 6 years following planting. These figures suggest that site preparation practices on cutover forest land are often insufficient for establishing pine plantations.

GROWTH PER ACRE CAN BE INCREASED BY ALMOST 50 PERCENT

In the projections made to determine prospective timber supplies, growth per acre increased from 52 to 60 cubic feet. A second set of projections estimated the potential timber supplies attainable over the same 30-year period through improved timber management. Here, growth per acre increased from 52 to 77 cubic feet. This rate more nearly reflects the inherent growth potential of Virginia's timberland with fully stocked natural stands.

In the projection of *potential* supplies, management goals were expressed in terms of basal area per acre and a stand-structure quotient for both softwoods and hardwoods. The stand-structure quotient is determined by dividing the number of trees in any 2-inch-diameter class by the number in the next larger class. In even-aged management, this quotient reflects the age distribution of the stands.

The goals selected for projection control would allow average stand densities of growing-stock trees 5.0 inches d.b.h. and larger to increase from 56 to 80 square feet per acre. Although this goal calls for only a 17 percent gain over the prospective increase when all species

Table V. – Area of commercial forest land, by stand origin and Survey Unit, Virginia, 1977

Stand origin	State		Survey Unit									
			Coastal Plain		Southern Piedmont		Northern Piedmont		Northern Mountain		Southern Mountain	
	M acres	*Percent*	*M acres*	*Percent*	*M acres*	*Percent*	*M acres*	*Percent*	*M acres*	*Percent*	*M acres*	*Percent*
Natural stands with no evidence of artificial regeneration	15,097.8	94.5	3,549.7	88.7	3,522.1	93.2	2,431.1	95.2	2,602.9	99.1	2,992.0	99.3
Stands originating wholly or in part from artificial regeneration since 1966	610.7	3.8	303.7	7.6	186.4	4.9	91.2	3.6	13.4	0.5	16.0	0.5
Stands originating wholly or in part from artificial regeneration prior to 1966	264.3	1.7	150.1	3.7	69.9	1.9	29.8	1.2	9.4	0.4	5.1	0.2
All stands	15,972.8	100.0	4,003.5	100.0	3,778.4	100.0	2,552.1	100.0	2,625.7	100.0	3,013.1	100.0

Table VI. – Area of commercial forest land, by broad management, ownership, and past treatment or disturbance classes, Virginia, 1977

Broad management and ownership classes[1]	Total area	Primary treatment or disturbance between 1966 and 1977							
		Harvesting with artificial regeneration	Harvesting with natural regeneration	Other harvesting	Intermediate cutting	Artificial planting	Natural disturbance	Other[2]	None
	Thousand acres								
Nonstocked forest:									
Public	40.3	–	–	6.9	3.6	–	2.2	–	27.6
Forest industry	37.2	–	–	30.2	–	–	–	–	7.0
Other private	174.9	–	5.6	32.0	8.8	–	–	21.8	106.7
Total	252.4	–	5.6	69.1	12.4	–	2.2	21.8	141.3
Pine plantations:									
Public	4.4	4.2	–	–	–	0.2	–	–	–
Forest industry	371.8	171.5	–	–	3.0	76.6	–	5.8	114.9
Other private	303.5	122.6	–	–	8.9	76.9	7.5	4.3	83.3
Total	679.7	298.3	–	–	11.9	153.7	7.5	10.1	198.2
Natural pine stands:									
Public	217.5	–	5.7	–	24.4	–	6.2	6.9	174.3
Forest industry	418.6	–	23.3	3.5	37.0	–	52.3	3.4	299.1
Other private	2,086.0	–	91.8	22.9	239.5	–	125.0	97.1	1,509.7
Total	2,722.1	–	120.8	26.4	300.9	–	183.5	107.4	1,983.1
Oak-pine stands:									
Public	174.8	–	5.3	8.5	7.2	–	3.6	3.6	146.6
Forest industry	238.5	44.4	10.3	17.2	7.6	10.1	2.8	6.1	140.0
Other private	1,507.6	29.2	95.5	63.9	176.8	15.2	51.2	71.0	1,004.8
Total	1,920.9	73.6	111.1	89.6	191.6	25.3	57.6	80.7	1,291.4
Upland hardwood stands:									
Public	1,501.6	–	84.3	21.2	82.8	4.2	40.2	25.3	1,243.6
Forest industry	548.8	15.6	26.3	61.7	26.3	2.3	14.7	22.4	379.5
Other private	7,674.0	19.5	377.9	489.6	862.5	3.1	163.5	376.6	5,381.3
Total	9,724.4	35.1	488.5	572.5	971.6	9.6	218.4	424.3	7,004.4
Bottomland hardwood stands:									
Public	17.3	–	–	0.8	–	–	3.2	–	13.3
Forest industry	68.7	–	3.0	5.8	–	–	2.4	–	57.5
Other private	587.3	–	9.6	56.4	37.7	–	52.4	9.5	421.7
Total	673.3	–	12.6	63.0	37.7	–	58.0	9.5	492.5
All classes:									
Public	1,955.9	4.2	95.3	37.4	118.0	4.4	55.4	35.8	1,605.4
Forest industry	1,683.6	231.5	62.9	118.4	73.9	89.0	72.2	37.7	998.0
Other private	12,333.3	171.3	580.4	664.8	1,334.2	95.2	399.6	580.3	8,507.5
Total	15,972.8	407.0	738.6	820.6	1,526.1	188.6	527.2	653.8	11,110.9

[1] Forest industry includes lands under long-term lease.

[2] Includes grazing, draining, prescribed burning, site preparation, and other miscellaneous treatments.

are grouped, it would require a gain of almost 30 percent for softwoods to be attained through improved pine regeneration practices. The management goals assumed a stand-structure quotient of 1.7 for both softwoods and hardwoods. Finally, it was assumed that softwood mortality rates could be reduced by 75 percent within 15 years, and hardwood mortality rates could be gradually reduced by 50 percent over the next 30 years. The more optimistic assumption used for softwoods is based on the fact that the base mortality rates reflect an unusually high loss of pines to bark beetles.

If the same assumptions are applied with regard to the decline in acreage as were applied in the prospective projections, *potential* annual cut climbs to 1,179 million cubic feet by year 2006, and would include 3,946 million board feet of sawtimber. The most significant increase over prospective supplies occurs in the volume of softwood (fig. 10). To achieve and sustain an inventory capable of supporting these levels of cut would require some shift in timber use from softwood to hardwood early in the projection period, along with improved regeneration of pine following harvesting.

STAND-AGE DISTRIBUTION REFLECTS RECENT PINE PLANTINGS

The distribution of commercial forest acreage by stand-age class and major forest type provides another indicator of future timber supplies. A stand-age profile of Virginia's timberland clearly shows the acceleration in pine planting during the past decade (fig. 11). For example, pine stands less than 10 years old occupy 708,000 acres, or 21 percent of the total acreage supporting pine forest types. About 60 percent of these young stands are plantations. Young stands are expected to replace natural stands 40 or more years old, which now occupy almost 1 million acres. Because of their age, these natural stands have accumulated average volumes of growing stock in excess of 2,000 cubic feet per acre. If the plantations are harvested 20 to 30 years in the future at ages of 30 to 40 years, they will contain little if any more volume than that which has now accumulated in old natural stands. The age distribution of pine stands, therefore, tends to support the earlier conclusion that only a modest increase can be expected in softwood timber supplies over the next 30 years.

70 PERCENT OF THE HARDWOOD STANDS ARE 40 YEARS OF AGE OR OLDER

Unlike pine stands, hardwood stands are concentrated in the older age classes. Of some 10.3 million acres with a manageable stand of hardwoods, 70 percent supported stands 40 years of age or older. Many of these stands have already reached maturity and most of the others will reach maturity over the next 30 years. Collectively, these stands offer the greatest opportunity for increasing timber cut over the next several decades.

Over the longer run, acreage deficiencies in the younger age classes, together with some 2.4 million acres so poorly stocked that a manageable stand does not exist, pose problems. Recent rates of hardwood harvesting and regeneration would have to be increased to correct the stocking deficiencies and unbalanced age distribution of the stands on the 12.5 million acres of hardwood type. Existing hardwood markets in Virginia cannot absorb the increase in hardwood harvesting opportunities implied in this age-stand profile. If current trends continue, average hardwood rotations will be extended and a large reserve of overmature stands will accumulate, resulting in substantial growth loss.

Of the 2.3 million acres of hardwood type without a manageable stand, about 53 percent had experienced no significant treatment or disturbance during the 11-year remeasurement period. The poorly stocked conditions on this acreage are not likely to improve without some intervention. Timber cutting or other types of disturbance during the same period contributed to the poor stocking conditions on the remaining 47 percent; therefore, the condition of some of these acres will improve. In both cases, many of the acres formerly supported pine stands.

Average volume per acre shown for each condition or age class in figure 11 excludes the volume in rough and rotten trees and all trees less than 5.0 inches d.b.h. Mortality, thinnings, and other types of intermediate cutting had also removed undetermined amounts of volume from some of the stands. The average volumes demonstrate the minimum performance of reasonably well-stocked stands across the range of sites.

185,000 ACRES HARVESTED ANNUALLY EXCLUDING DIVERSIONS AND INTERMEDIATE CUTTINGS

Measures of recent rates of forestry activities are needed before examining the management opportunities available for closing the gap between prospective and potential timber supplies in Virginia. In this latest inventory, crews determined the most significant treatment or disturbance evidenced at each sample location during the 11-year remeasurement period. A summary of this treatment and disturbance information by broad management and ownership classes provides a measure of recent forestry activities (table VI). Note that the

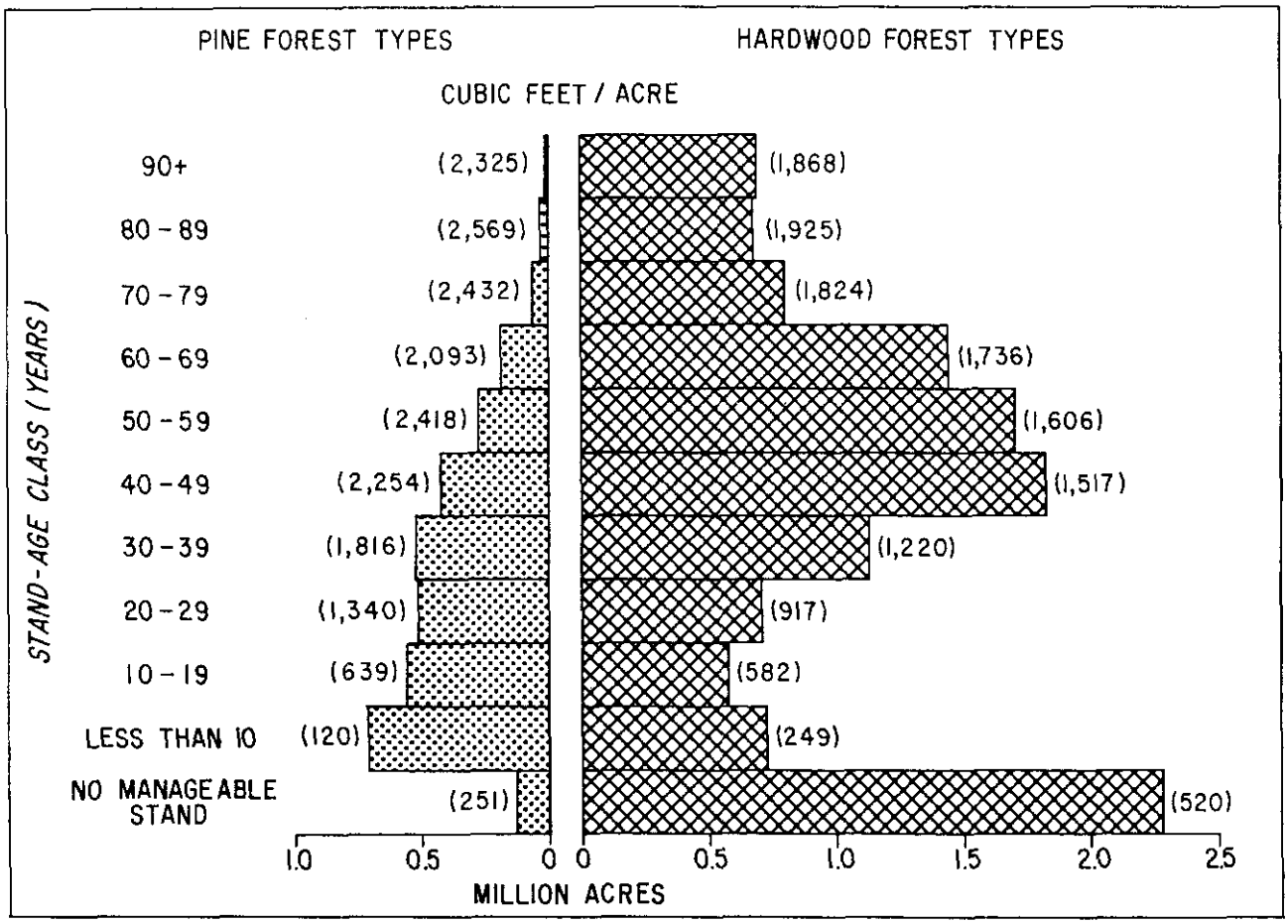


Figure 11. — Profile of area of commercial forest land, by stand-age class, by pine and hardwood forest types, with average volume of growing stock per acre (in parentheses), Virginia, 1977.

management classes describe the stands at the end of the remeasurement period rather than at the beginning.

Timber harvesting was the most common forestry activity observed. Of the nearly 16.0 million acres classified as commercial forest, almost 2.0 million acres had been harvested since the 1966 inventory. On the average, 185,000 acres were harvested annually and retained as commercial forest. Evidence of thinning or other types of intermediate cutting was observed on an additional 1.5 million acres. These figures exclude almost 0.5 million acres withdrawn or diverted to other land uses during the period. Timber on some of this acreage was also harvested. When the estimates of harvesting, intermediate cutting, and diversions are grouped, timber was removed from 360 acres annually.

Observations of recent treatment and disturbance indicated about 610,000 acres had been artificially reforested. A breakdown of this reforestation effort shows 68 percent occurred on forest acres also harvested during the remeasurement period. Another 11 percent was on old fields or other nonforest land. The remaining 21 percent of the planting effort was on the backlog of acreage needing regeneration.

Other significant treatments or disturbances by man were observed on 654,000 acres. These practices included forest grazing, draining, prescribed burning, site preparation, and other miscellaneous disturbances. Finally, conditions observed on an additional 527,000 acres had been significantly affected by natural disturbances. These natural disturbances included insect infestations, wildfire, disease, and weather. Estimates fail to reflect the full extent of these treatments and disturbances because one type of treatment or disturbance often masks another that may have occurred in the same stand.

70 PERCENT OF THE STANDS WERE UNDISTURBED

No evidence of significant treatment or disturbance within the remeasurement period was found on 11.1 million acres, or 70 percent of the land classified as com-

mercial forest. By region, the proportion of undisturbed stands ranged from a high of 79 percent in the Mountains to a low of 64 percent in the Piedmont. In the Coastal Plain, 65 percent of the stands had not been disturbed. By ownership class, the proportion of undisturbed stands ranged from a high of 82 percent on public lands to a low of 59 percent on lands owned or leased by forest industries. The proportion was 69 percent on other private lands. By broad management class, the proportion undisturbed ranged from 73 percent for both natural pine and bottomland hardwood stands to only 29 percent for pine plantations.

About 23 percent of the undisturbed stands were on sites unfavorable for intensive silvicultural practices either because of steep slopes or year-round water problems. Only 13 percent of the treated or disturbed stands occurred on similar sites.

Table 9. – Area of noncommercial forest land, by forest types, Virginia, 1977

Type	All areas	Productive-reserved areas	Unproductive areas
		Acres	
Loblolly-shortleaf pine	27,110	27,110	–
Oak-pine	9,786	9,786	–
Oak-hickory	361,298	291,273	70,025
Oak-gum-cypress	46,392	46,392	–
All types	444,586	374,561	70,025

Table 10. – Number of growing-stock trees on commercial forest land, by species and diameter class, 1977

Species	All classes	Diameter class (inches at breast height)									
		5.0–6.9	7.0–8.9	9.0–10.9	11.0–12.9	13.0–14.9	15.0–16.9	17.0–18.9	19.0–20.9	21.0–28.9	29.0 and larger
						Thousand trees					
Softwood:											
Longleaf pine	–	–	–	–	–	–	–	–	–	–	–
Slash pine	–	–	–	–	–	–	–	–	–	–	–
Shortleaf pine	89,357	36,896	27,107	15,063	6,837	2,487	683	166	81	37	–
Loblolly pine	227,840	104,500	52,741	29,339	19,581	11,290	6,055	2,717	1,018	593	6
Pond pine	1,050	101	242	167	268	111	92	41	26	–	2
Virginia pine	242,001	116,582	74,082	34,029	12,998	3,429	718	121	33	9	–
Pitch pine	26,818	6,958	6,500	6,067	4,018	1,988	828	356	56	47	–
Table-Mountain pine	10,848	4,175	2,901	1,914	983	639	149	64	23	–	–
Spruce pine	–	–	–	–	–	–	–	–	–	–	–
Sand pine	–	–	–	–	–	–	–	–	–	–	–
Eastern white pine	31,956	10,683	7,568	5,163	3,283	2,568	1,360	666	321	331	13
Eastern hemlock	10,160	3,941	2,333	1,386	859	673	292	286	149	188	53
Spruce and fir	253	–	116	30	76	19	12	–	–	–	–
Baldcypress	1,365	139	133	174	233	241	162	65	85	117	16
Pondcypress	108	–	–	17	26	–	15	25	5	16	4
Cedars	19,024	13,336	4,130	1,146	287	101	11	13	–	–	–
Total softwoods	660,780	297,311	177,853	94,495	49,449	23,546	10,377	4,520	1,797	1,338	94
Hardwood:											
Select white oaks[1]	193,398	70,094	45,861	30,818	19,230	12,446	7,347	3,805	1,892	1,773	132
Select red oaks[2]	61,597	17,690	13,306	9,222	7,465	5,418	3,179	1,964	1,351	1,758	244
Chestnut oak	143,045	49,728	35,754	22,427	13,625	8,738	5,849	3,152	1,720	1,909	143
Other white oaks	11,930	5,054	2,948	1,540	1,144	790	224	67	84	67	12
Other red oaks	210,274	73,584	52,300	35,158	20,955	13,882	7,336	3,667	1,737	1,521	134
Hickory	107,627	42,578	26,117	17,612	9,538	5,905	3,114	1,619	607	504	33
Yellow birch	377	90	137	29	–	42	28	34	–	17	–
Hard maple	11,501	4,692	2,660	1,810	939	542	394	207	137	110	10
Soft maple	90,339	41,843	21,601	13,067	6,464	3,180	2,075	1,023	497	550	39
Beech	20,795	7,367	3,640	2,804	2,234	1,612	1,176	858	533	529	42
Sweetgum	79,024	35,615	19,471	10,866	6,252	3,496	1,670	851	422	365	16
Tupelo and blackgum	33,271	13,945	7,022	5,138	3,075	2,002	1,147	470	215	237	20
Ash	16,075	6,061	3,676	2,232	1,820	1,093	676	281	103	115	18
Cottonwood	417	143	145	71	16	–	23	–	–	19	–
Basswood	6,074	1,203	1,231	1,080	1,070	634	428	201	78	142	7
Yellow-poplar	157,832	49,859	34,088	26,922	19,669	12,635	7,290	3,849	1,731	1,676	113
Bay and magnolia	8,490	3,652	2,661	1,281	458	212	57	39	82	44	4
Black cherry	3,460	1,490	921	395	281	228	64	44	15	22	–
Black walnut	6,775	2,210	1,719	928	842	551	255	157	85	15	13
Sycamore	6,947	1,219	1,429	1,087	1,325	662	521	266	174	226	38
Black locust	20,036	6,116	6,448	3,899	1,946	969	393	161	50	54	–
Elm	9,112	3,589	2,808	1,132	679	391	272	77	79	75	10
Other eastern hardwoods	36,132	16,227	9,094	4,935	2,563	1,611	760	420	189	313	20
Total hardwoods	1,234,528	454,049	295,037	194,453	121,590	77,039	44,278	23,212	11,781	12,041	1,048
All species	1,895,308	751,360	472,890	288,948	171,039	100,585	54,655	27,732	13,578	13,379	1,142

[1] Includes white, swamp white, swamp chestnut, and chinkapin oaks.
[2] Includes cherrybark and northern red oaks.

Table 29. – Basal area per acre of growing stock and rough and rotten trees 5.0 inches d.b.h. and larger, by forest type and Survey Unit, Virginia, 1977

Forest type	State	Survey Unit				
		Coastal Plain	Southern Piedmont	Northern Piedmont	Northern Mountain	Southern Mountain
	Square feet					
White pine-hemlock:						
Growing stock	61.1	–	51.9	39.4	58.8	66.4
Rough and rotten trees	13.7	–	16.3	–	17.1	13.1
All trees	74.8	–	68.2	39.4	75.9	79.5
Loblolly-shortleaf pine:						
Growing stock	60.8	67.6	54.8	56.4	50.4	52.0
Rough and rotten trees	5.3	4.7	4.0	4.7	15.2	12.2
All trees	66.1	72.3	58.8	61.1	65.6	64.2
Oak-pine:						
Growing stock	52.5	56.1	50.0	47.7	48.9	52.9
Rough and rotten trees	10.5	8.5	8.6	8.7	18.8	16.7
All trees	63.0	64.6	58.6	56.4	67.7	69.6
Oak-hickory:						
Growing stock	55.3	53.9	52.5	60.9	55.1	54.7
Rough and rotten trees	16.5	12.2	12.9	13.4	24.7	20.7
All trees	71.8	66.1	65.4	74.3	79.8	75.4
Oak-gum-cypress:						
Growing stock	67.4	67.6	61.3	63.8	–	–
Rough and rotten trees	30.7	31.3	5.0	33.8	–	–
All trees	98.1	98.9	66.3	97.6	–	–
Elm-ash-cottonwood:						
Growing stock	46.9	49.3	49.3	38.0	41.7	50.0
Rough and rotten trees	19.7	21.0	16.3	22.4	23.8	28.8
All trees	66.6	70.3	65.6	60.4	65.5	78.8
Maple-beech-birch:						
Growing stock	61.2	–	–	–	55.4	62.2
Rough and rotten trees	23.4	–	–	–	38.5	20.7
All trees	84.6	–	–	–	93.9	82.9
All types:						
Growing stock	56.4	59.9	52.8	58.0	53.8	55.1
Rough and rotten trees	13.8	11.0	10.1	11.3	23.2	19.8
All trees	70.2	70.9	62.9	69.3	77.0	74.9

Table 30. – Number of growing-stock and rough and rotten trees 1.0–4.9 inches d.b.h. per acre, by forest type and Survey Unit, Virginia, 1977

Forest type	State	Survey Unit				
		Coastal Plain	Southern Piedmont	Northern Piedmont	Northern Mountain	Southern Mountain
	Number of trees					
White pine-hemlock						
Growing stock	265	–	333	851	267	182
Rough and rotten trees	203	–	200	–	356	147
All trees	468	–	533	851	623	329
Loblolly-shortleaf pine:						
Growing stock	466	478	496	499	198	279
Rough and rotten trees	317	374	257	234	373	318
All trees	783	852	753	733	571	597
Oak-pine:						
Growing stock	323	329	415	340	206	195
Rough and rotten trees	437	474	465	320	398	410
All trees	760	803	880	660	604	605
Oak-hickory:						
Growing stock	190	222	216	213	127	162
Rough and rotten trees	407	430	456	310	448	378
All trees	597	652	672	523	575	540
Oak-gum-cypress:						
Growing stock	152	152	167	100	–	–
Rough and rotten trees	477	487	167	300	–	–
All trees	629	639	334	400	–	–
Elm-ash-cottonwood:						
Growing stock	106	123	90	179	33	67
Rough and rotten trees	286	427	263	157	222	167
All trees	392	550	353	336	255	234
Maple-beech-birch:						
Growing stock	133	–	–	–	75	144
Rough and rotten trees	233	–	–	–	325	217
All trees	366	–	–	–	400	361
All types:						
Growing stock	266	315	312	288	142	170
Rough and rotten trees	387	425	391	291	430	363
All trees	653	740	703	579	572	533